

# Flourishing trees, flourishing minds: nearby trees may improve mental wellbeing among housing association tenants

## Abstract

Interventions to create even a small change in the average level of mental wellbeing across the population could have very high economic and social returns. Decision makers would thus be more likely to allocate space and funding for urban trees if a positive relationship to the mental wellbeing of the surrounding population can be evidenced.

This study undertook a 'natural experiment'. It used a validated scale to quantifiably assess the effects of residential trees on mental wellbeing, within largely randomly assigned participants living in housing association properties, with the significant environmental and socio-economic variables held broadly constant. It used a bespoke scale, set against statements, to quantifiably assess participants' general perceptions of residential trees and this relationship on mental wellbeing.

Tenants with high nearby tree cover had a higher mean reported mental wellbeing than those with negligible levels, indicating that nearby trees may provide aids in improving mental wellbeing for certain groups. There was a generally positive response to nearby trees and a desire from those with negligible existing levels for increased tree cover. While avoiding sweeping claims, the implications are that investments in residential trees could result in higher mean levels of mental wellbeing for certain groups, with the associated benefits this brings to the individual and wider community.

## Introduction

The common assumption that contact with nature fosters mental wellbeing and reduces the stress of urban living is seemingly as old as urbanisation itself (Ulrich *et al.*, 1993). The first great act of greenspace creation in modern history, the Victorian park, occurred because the park-makers believed intuitively in the healing and redemptive values of nature (Nicholson-Lord, 2006).

Greater pressure on urban land is now limiting the space available for trees (Britt and Johnston, 2008); thus intuitive arguments for increased tree cover carry little weight with decision makers who have to justify all outgoing costs. The resources allocated to urban forestry programmes are heavily influenced by the extent to which rigorous research demonstrates that such measures improve outcomes and are cost effective.

It is now accepted that interventions to create even a small change in the average level of mental wellbeing across the population could have very high economic and social returns (Jenkins *et al.*, 2008); thus decision makers will be more likely to allocate space and funding for urban trees if a positive relationship to the mental wellbeing of the surrounding population can be evidenced.

This research aimed to objectively assess the potential of nearby trees to improve the mental wellbeing of residents living in poorer urban communities, and to understand the intrinsically linked issues of how these residents perceive trees and negotiate this relationship with mental wellbeing.

### Keywords:

attitudes, mental health, residential trees, urban forestry

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## Mental wellbeing

Despite a large amount of related research, it is suggested that a single definition of mental wellbeing remains unresolved (Carlisle and Hanlon, 2008). However, it is agreed that the term encompasses more than the absence of mental illness; mental wellbeing being something we all have and seek to improve. The term is often used interchangeably with the terms positive mental health or psychological wellbeing or simply wellbeing. The World Health Organisation (2004) defined positive mental health as a state which allows individuals to realise their abilities, cope with the normal stresses of life, work productively and fruitfully, and make a contribution to their community.

Mental wellbeing is described as a continuum ranging from good or high mental health, or flourishing, at one end, to poor mental health, or languishing, at the other end of the continuum (Keyes, 2002). Historically, mental health measurement has divided the population into those who meet the criteria for diagnosis of mental illness and those who do not. However, such methods are unable to distinguish average from good mental health (Stewart-Brown *et al.*, 2009).

Recent developments confirm mental wellbeing as a valid construct that can be measured reliably. The Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS) (Parkinson, 2006) is now an established approach to the assessment of mental wellbeing at population levels; it was developed specifically to measure positive mental health with all the items representing positive thoughts or feelings. It has been used in several large-scale health surveys and is to be included in the National Health Survey for England in 2011 (Deacon *et al.*, 2009).

Factors found to affect mental wellbeing include an individual's genotype (Argyle, 1999; Keverne, 2005), socially developed characteristics (McKee-Ryan *et al.*, 2005) and socio-economic factors; whereby the higher people are on the social hierarchy the lower their risk of poor mental health (Bajekal and Osbourne, 2006). It is also accepted that the built environment may potentially affect wellbeing through multiple pathways (Northridge *et al.*, 2003).

The cost of mental ill health and poor mental wellbeing to the care and wider economy is estimated at £76 billion per annum (SDC, 2008). As such, if interventions were to create even a small change in the average level of mental wellbeing across the population they could have very high economic and social returns (Jenkins *et al.*, 2008). Because of this, mental wellbeing research is producing a burgeoning

evidence base for policy, aiming to promote positive mental wellbeing as a target for population-level interventions (Marmot Review, 2010).

## Can the urban forest promote mental wellbeing?

Urban trees mitigate many negative environmental impacts such as the heat island effect, flooding and air pollution, thus having many indirect health and wellbeing benefits. However, the mechanisms by which urban trees or 'nature' may independently provide specific health and mental wellbeing benefits have been largely underpinned by psycho-evolutionary or 'biophilia' theory, whereby millions of years of evolution have left modern humans with a partly genetic predisposition to respond positively to nature (Wilson, 1984; Kellert, 1993).

In applied research the two prominent restorative theories, separate yet congruous with the biophilia hypothesis, attempt to evidence how such affects on health take place. Psycho-physiological stress recovery theory (Ulrich *et al.*, 1991) suggests that health effects occur because experiencing and viewing natural scenes immediately initiates the physiological and psychological responses that underpin recovery from stress. Attention Restoration Theory (ART) (Kaplan and Kaplan, 1989) suggests natural environments allow the human brain, fatigued from the prolonged directed attention required in urban areas, to be refreshed.

Generally underpinned by one of these two theories, an increasing amount of research has attempted to test links between greenspace, health and wellbeing. Recent general reviews of the evidence include Maller *et al.*, (2008), O'Brien *et al.*, (2010) and Lee and Maheswaran, (2011). The research can be broadly grouped into descriptive studies, including epidemiological and qualitative studies, and quasi-experimental studies. While proving causality is difficult, the quantity and variety of research suggests that greenspace can improve mental wellbeing and that it can be of particular benefit to people from more deprived urban communities. However, Lee and Maheswaran's (2011) review highlights a lack of robust evidence, noting many studies were limited by poor study design.

A methodological weakness with much of the existing research is confounding. While able to factor for direct selection effects such as income, most studies are unable to distinguish personal characteristics and cannot therefore differentiate whether green environments lead to increases

in health and wellbeing or whether healthier and happier people self-select into greener neighbourhoods. Many are small studies with poor statistical power, relying heavily on anecdotal evidence. There is often also the possibility of information bias, based on the subject's preconceptions and them wanting to please investigators with their responses. Most studies do not distinguish between different types of greenspace and fail to identify the specific role of urban trees as a constituent part, or else compare even more loosely defined 'urban' and 'natural' environments. Thus robust generalisations in relation to tree cover in an urban residential context are difficult. Similarly, there are complexities around the perceptions of trees, with access and social inequality issues inextricably linked to any possible benefits gained.

Largely as a result of the complications involved in randomly assigning people to specific settings, there are few robust randomised controlled trials. However, some studies have undertaken 'natural experiments', which overcame many of the aforementioned design weaknesses. These include those that used randomly assigned tenants of public housing (Kuo, 2001; Kuo and Sullivan, 2001a, 2001b); or surgery patients who had a bedside window view of either trees or a brick building wall (Ulrich, 1984). These early quasi-experimental studies provide some of the most robust evidence that exposure to views of trees may have restorative effects in terms of cognitive function and stress reduction. Their relative methodological strength is highlighted by their continued reference in even the most recent recommendations and policy (e.g. Marmot Review, 2010; British Medical Association, 2011).

Explicit research gaps identified in the reviews include the importance of trees very close to residences to mental wellbeing; clarification of the relative importance of trees as a potential mental health mechanism in deprived urban communities; and research to explore residents' understandings of the relationship between trees and health and wellbeing. This study aimed to address these research issues by asking the following questions.

## Research questions

- With all other significant variables held broadly constant, do randomly assigned tenants living in properties with high levels of nearby tree cover have a higher reported mental wellbeing than those with negligible levels?
- What are tenants' general attitudes towards nearby trees and how does this relate to mental wellbeing?

## Method

### The basic approach

Aiming to adhere to the spirit of Kuo's (2001) methodological criteria, this study undertook a 'natural experiment'. It used a validated mental wellbeing scale to quantifiably assess the effects of residential trees within largely randomly assigned participants living in housing association properties, with the significant environmental and socio-economic variables held broadly constant. It used a bespoke scale, set against statements, to quantifiably assess participants' general perceptions of residential trees and this relationship to mental wellbeing.

### Sample group

The sample group were tenants renting properties from Chevin Housing Association (CHA), a charity that owns and manages around 6000 rented homes, predominantly throughout the Yorkshire region. Properties are focused on those in the lower-income brackets or in particular need. CHA lettings policy defines people in the most need via a banding system depending upon applicants' circumstances. Because rent is subsidised, most properties have a waiting list and, although applicants can apply for their choice of scheme, in practical terms, limited availability means that when a flat becomes available it is taken by those next on the waiting list. This results in a largely random assignment of residents and provides the advantages of a near-randomised trial, with selection bias (of the people choosing flats with nearby trees differing from people who choose flats without trees) largely removed. Tenants have no direct role in managing the trees outside their buildings, including decisions to introduce or remove trees.

### Variables

Socio-demographic variables shown to have significant differences on mental wellbeing were ascertained through details held by CHA and from the Office for National Statistics. The two participant groups were thus broadly homogeneous with regard to age, gender, tenants in single living accommodation, tenants identifying themselves as black or ethnic minorities, and those identifying themselves as having a disability. Any minor variations were assessed via a t-test and were not statistically significant.

The Index of Multiple Deprivation provides a nationally consistent measure of how deprived an area is by identifying the degree to which people are disadvantaged by factors such as low income, unemployment, lack of education,

poor health and crime at Lower-layer Super Output Area (LSOA) level in England. The four neighbouring local authorities used within this study rank 5th, 6th, 7th, and 8th from the list of 21 within the Yorkshire region. All have a similarly high relative proportion of LSOAs in the most deprived quintile (ONS, 2007).

No specific participant income data was assessed as part of this study. However, due to the CHA lettings policy it is reasonable to assume an even mix of income types and employed/unemployed tenants exists within the two groups. Within the wider social rented sector, over half the households are economically inactive and unemployment is higher than any other household type (ONS, 2009).

Objective quantified measures were used as the basis for assignment to conditions of high surrounding tree cover ('green') (see Figure 1) or negligible surrounding tree cover ('grey') (see Figure 2). Data from the Office for National Statistics ensured there were no systematic differences between grey and green schemes in levels of surrounding greenspace within the wider ward area and in amount of land that was occupied by buildings and roads. A measurement of the nearest open greenspace from each selected scheme was obtained from Google Earth imagery, ensuring all schemes had some greenspace within 300 metres, as per the Standard from Natural England (2009). Other environmental variables were assessed using data held by CHA, Google Earth imagery and site visits, ensuring size, layout and number of residential units were broadly constant throughout the two groups.

Significant grassed areas and shrub beds were limited throughout all the schemes, thus vegetation was largely limited to tree cover. However, in practical terms it

was not possible to have grey scheme views completely barren; several had some limited vegetation within the surrounding landscape. Furthermore, while the wider environment was assessed, it cannot be assumed that there were no occasional trees on the horizon, visible from the upper floors.

Evidently participants were not 'blind' to their surroundings, but were 'blind' as to the ultimate specifics of the research, with the mental wellbeing scale being undertaken first prior to any specific mention of trees, so as to avoid any information bias or confounding responses.

## Measures

The independent variable of the study was nearby trees; the primary dependent variable was mental wellbeing. This was measured with the Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS). It uses a five-point scoring system, with responses ranging from 'none of the time' through to 'all of the time'. A score is attributed to each response for each of the seven items in the scale:

- I've been feeling optimistic about the future
- I've been feeling useful
- I've been feeling relaxed
- I've been dealing with problems well
- I've been thinking clearly
- I've been feeling close to other people
- I've been able to make up my own mind about things

*Scores:*

None of the time = 1. Rarely = 2. Some of the time = 3. Often = 4. All of the time = 5.

**Figure 1** High tree cover 'green scheme'.



**Figure 2** Negligible tree cover 'grey scheme'.





The secondary dependent variable for the study was attitudes to residential trees, and the belief in the power of trees and the environment to be salubrious. This was measured with a similar Likert scale, asking residents to agree/disagree to a series of opinion statements on a five-point scale, with possible responses ranging from one (strongly disagree) to five (strongly agree):

- It's important to me how the local area looks
- I would like to see more trees around where I live
- How the local environment looks makes a difference to how I feel
- Trees should be in parks and woodlands, not close to where I live
- Trees and nature make me feel calm and relaxed
- Trees around flats cause too many problems

Both scales use a five-point system, thus individuals were given a mean score for each scale and for each statement. T-tests allowed for the mean ratings for the green and grey group to be compared. To account for any invalid responses if a response to one item was missing, a midpoint score of three was used. Across the two groups, four respondents (2% of participants) did not have a full total score.

## Procedure

Following CHA consent, variables were assessed resulting in 14 comparable schemes (7 grey and 7 green) with 425 potential properties (196 grey and 229 green). An introductory letter to tenants was composed, with advice from members of CHA with relevant expertise. This clearly outlined what would be involved in the research and requested those who did not wish any further part to opt out before the date specified. Any tenants deemed unsuitable by CHA due to ethical or safety reasons were removed from the mailing list and the letter was posted to 388 tenants. The schemes were then visited between 10am and 6pm over a three-week period in October 2009. Individual potential participants were contacted via residential intercoms. After an initial introduction, consenting participants then came to their doorstep and were invited to self-complete the SWEMWBS followed by the attitudinal scale.

## Results

### Participant response

Of the 388 tenants who were invited to participate, 63 tenants chose to opt out of any further participation;

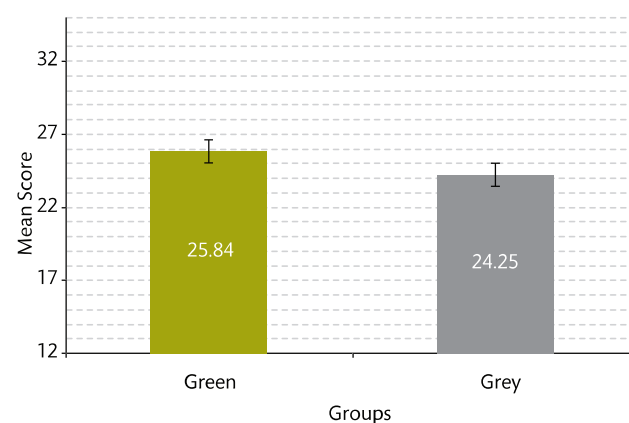
yielding a final sample of 325 (170 green and 155 grey). Of the properties visited, two participants refused, when asked for further consent, after looking at the SWEMWBS scale. Approximately 15% of participants were unable or unwilling to self-complete the scales, thus the researcher read out the statements and completed the scales as per their response. Data collection stopped after 200 responses (100 green and 100 grey) had been collected. All of the schemes were visited, with several schemes requiring multiple visits so as to find the tenants at home.

## Discussion

### Answering the main research question

The difference between the grey and green group participants combined mean is considered to be statistically significant ( $t = 2.2622$ ,  $df = 198$ ,  $p < 0.0248$ ). Thus the study has shown that there is a statistically significant difference in the mean reported mental wellbeing of randomly assigned tenants; those with high nearby tree cover had a higher mean reported mental wellbeing than those with negligible levels (Figure 3).

Figure 3 Group mental wellbeing means.



The mean mental wellbeing score for all participants was 25.04. The standard deviation was 4.97. Thus cut-off points were applied, based on one standard deviation above or below the mean. This allowed comparisons of mental wellbeing levels as assessed by the proportions of populations with relatively high, moderate and low mental wellbeing. Interestingly, a significantly higher proportion of the green group participants had a high (flourishing) level of mental wellbeing, yet the grey group did not have a larger proportion with lower than average (languishing) wellbeing (Figure 4).

Of the seven SWEMWBS statements, there were no significant differences of combined mean scores by group for 'feeling optimistic' ( $t = 0.1335$ ,  $df = 198$ ,  $p < 0.8940$ ), 'dealing with problems well' ( $t = 1.7012$ ,  $df = 198$ ,  $p < 0.0905$ ), 'feeling close to others' ( $t = 1.3676$ ,  $df = 198$ ,  $p < 0.139$ ) and 'able to make my own mind up', with both groups having a mean score of 4.1.

There were very significant differences between the two groups' mean scores for the statements 'feeling useful' ( $t = 2.8806$ ,  $df = 198$ ,  $p < 0.0044$ ) and 'feeling relaxed' ( $t = 3.0224$ ,  $df = 198$ ,  $p < 0.0028$ ), and there was a significant difference for 'thinking clearly' ( $t = 2.5347$ ,  $df = 198$ ,  $p < 0.0120$ ), with the green group scoring a higher mean score for these statements (Figure 5).

Figure 4 Distribution of wellbeing scores between groups.

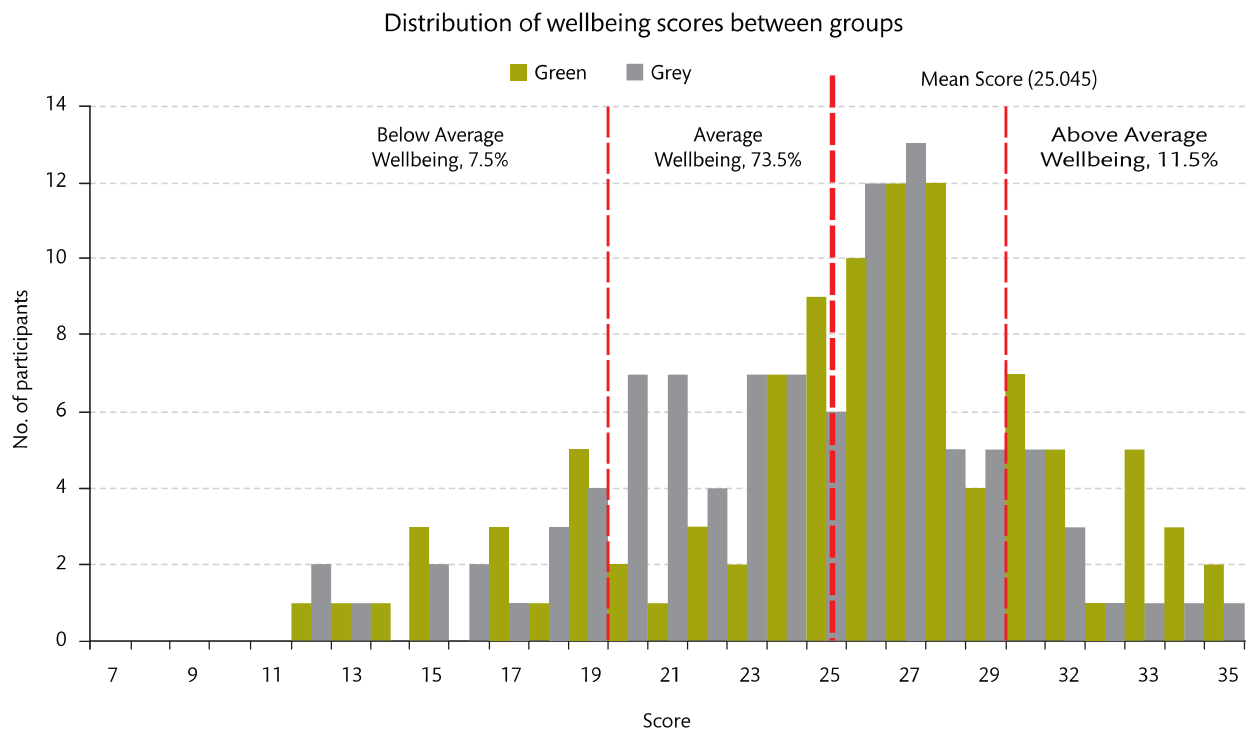


Figure 5 Mean results of SWEMWBS statements.

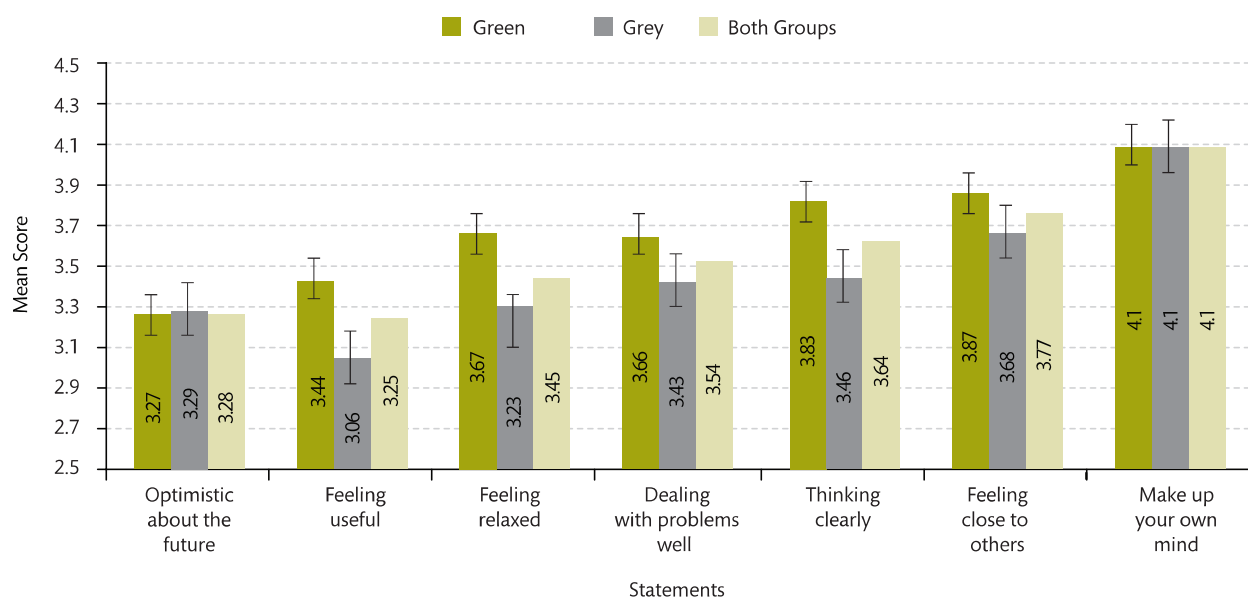
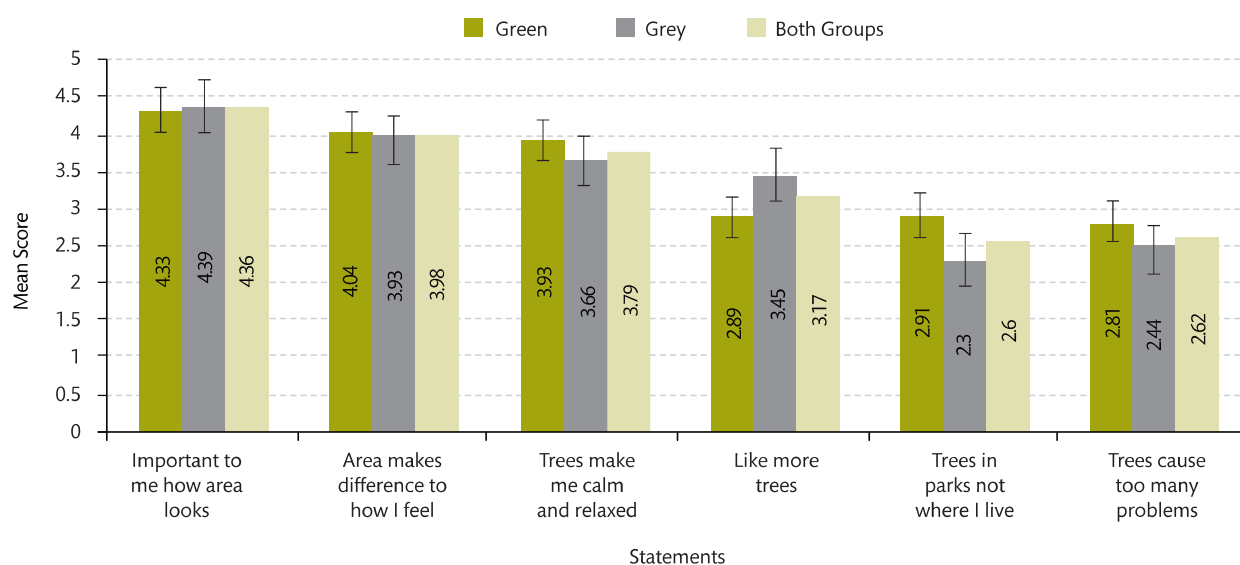


Figure 6 Participant attitudinal statement results.



## Relating these results to existing knowledge

The most striking difference between the two group means was for the statement 'I've been feeling relaxed'. While no specific physiological measure of stress was undertaken, it is not unreasonable to suggest feeling relaxed is the antonym of feeling stressed. Thus this result is broadly consistent to Ulrich *et al.*'s (1991) theory and research of stress reduction, whereby the mechanism responsible for health effects occur because experiencing and viewing natural scenes immediately initiates the physiological and psychological responses that underpin recovery from stress.

Similarly, although the study did not use specific tests of directed attention, both the 'thinking clearly' and 'feeling useful' statements could be understood as aspects of restored capabilities of cognitive function. Thus these findings are broadly congruent with ART theory (Kaplan and Kaplan, 1989) and its wider body of research on cognitive function and greenspace (e.g. Kuo and Sullivan, 2001a).

Other than more general research relating to the wider impact of the surrounding environment on mental wellbeing (Northridge *et al.*, 2003), there is no explicit evidence from the existing literature as to why the statements relating to optimism, dealing with problems and making up one's own mind would have a specific association with surrounding tree cover. It is conceivable that higher levels of social interaction resulting from nearby trees would have been evidenced by a higher green group mean score for the statement 'I've been feeling close to others', yet there were no significant differences of combined mean scores by group for this statement. This apparent lack of significance may be a

limitation of the understood meaning of the scale statement or method of measurement, or it may be suggestive of no significance in relation to social interaction and nearby trees.

## Attitudinal survey

A secondary aim of the study was to assess attitudes to nearby trees within largely randomly assigned tenant populations. The results show that attitudes towards nearby trees are generally positive. There was general disagreement or neutrality to the statements 'Trees should be in parks and woods, not close to where I live' and 'Trees around flats cause too many problems'. However, these statements did receive some noticeable support, with almost a quarter of all respondents 'agreed' or 'strongly agreed' with the respective statements. Yet overall those who did not wish to see more trees were in the minority (26.5%), which is a relatively small number considering the high levels of tree cover at the green sites (Figure 6).

## Attitudes by group

There is a very statistically significant difference by group for the statements 'I would like to see more trees around where I live' ( $t = 3.8584$ ,  $df = 198$ ,  $p < 0.0002$ ), with the grey group scoring a higher score, and for 'Trees should be in parks and woods, not close to where I live' ( $t = 4.2790$ ,  $df = 198$ ,  $p < 0.0001$ ), with the green group scoring a higher mean score. There is a smaller but still significant difference for 'Trees and nature make me feel calm and relaxed' ( $t = 2.2956$ ,  $df = 198$ ,  $p < 0.0227$ ) and 'Trees around flats cause too many problems' ( $t = 2.0709$ ,  $df = 198$ ,  $p < 0.0397$ ), with the green group scoring a higher mean score for these statements.

Grey group participants generally had a desire to have more trees around where they live; only 14% had a negative response to the statement 'I would like to see more trees around where I live'. Conversely, 39% of the green group had a negative response to this statement. However, as the green sites were specifically selected due to the high levels of surrounding tree cover, this may not be evidencing an adverse response to the existing levels of tree cover, but simply be acknowledging that the current levels are adequate.

There is a clear trend throughout the groups for the statements 'Trees should be in parks and woods, not close to where I live' and 'Trees around flats cause too many problems', with around twice as many of the grey group disagreeing, while the green group were more likely to neither agree nor disagree or agree with the statements. This is understandable, as those tenants living in schemes with high tree cover will clearly have a more direct understanding of any associated problems that come from living in close proximity to trees.

## The impact of beliefs

There was a strong belief from the participants in both the power of the surrounding environment and trees and nature to have beneficial effects on mental wellbeing. Only 6.5% of all participants disagreed or strongly disagreed with the statement 'Trees and nature make me calm and relaxed', and the green group participants were more likely to agree or strongly agree with the statement. This suggests that an appreciation of trees in this regard is enhanced with direct experience and highlights such dispositions, although conceptually understood and agreed with, may not fully actualise without direct experience.

Such an overwhelming lack of disagreement in the ability of trees and nature to relax people leads to perhaps the simplest explanation for the study's key findings, based on the power of people's belief systems or 'meaning effect'. Although the term may have negative connotations, the power of 'placebo' is widely documented and accepted in the medical field. Thus, while it is tempting to infer a psycho-evolutionary response or 'biophilia' as an explanation for the study's key results it would be rash to do so, as it is possible that the mechanisms by which mental wellbeing benefits take place are derived from people's belief systems. Such a mechanism would not undermine the restorative value of trees, but highlights the importance of the cultural meaning placed upon them.

## Strengths, weaknesses and further research

The results of the study are supportive of much previous research on greenspace and wellbeing links. However, the study was unique in a number of ways.

The surrounding levels of nearby greenspace were broadly similar between the two groups, thus the study specifically assessed nearby residential trees as opposed to 'greenspace'. However, no assessment of the quality of the greenspace was undertaken, nor was it assessed whether the participants used or were aware of it.

The vast majority of previous related work looks at how greenspace can reduce stressed or mentally fatigued individuals. This research did not look at how nearby trees may alleviate negative mental states but how they encourage positive mental states.

While all reasonable attempts were made at minimising any confounding factors, it must be accepted that in order to gain enough participant responses to make statistical analysis valid, the study essentially grouped 14 schemes in different immediate geographic locations into two groups. Thus it is always possible that unaccounted for variables other than surrounding trees may have influenced the results. Similarly, the specific characteristics of the sample group, tenants in housing association properties, cannot be extrapolated to the wider society without some caution.

The study is the first to use a nationally standardised measure of mental wellbeing to assess the impact of surrounding trees, and provides encouraging results as to the scale's wider application in future related studies. It is suggested that researchers should be alert to opportunities for similar 'natural experiments', possibly using existing or proposed urban developments or healthcare facilities, to further examine this potential of trees.

## Conclusion

The results of the study suggest that nearby residential trees may provide aids in improving mental wellbeing for more disadvantaged socio-economic groups. It has shown significant differences in mean mental wellbeing scores between randomly assigned populations who reside in similar housing schemes that largely differ only in the presence or absence of nearby trees. However, caution is advised before making claims regarding positive mental wellbeing benefits on this evidence alone, as there is a risk that this could lead to expectations about the effect of residential trees that could lead to disappointment.



The study also shows clearly that people generally respond positively to nearby trees and that there is a desire for those living in poorer urban areas with low tree cover to see more trees around where they live.

How nearby trees may be responsible for improved mental wellbeing scores is difficult to establish. The three statements with significant statistical differences could be understood conceptually in terms of stress reduction theory and ART, which is encouraging. Yet the results provide no direct evidence as to whether the mechanisms are culturally defined or biologically based. However, this should not detract from the study's key results. The implications of these are that investments in nearby residential trees could result in disadvantaged socio-economic groups having higher mean levels of mental wellbeing, with the considerable associated benefits that this has on the individual and wider community.

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